7. SOURCES OF INFORMATION

Individuals and organisations included in the circulation bst are underlined Other significance is denoted by *italics*

7.1 Published Works

There is a considerable, but widely distributed literature for the electricity industry However, this material tends to focus on technological and business history and remarkably little appears to have been done on the study of field remains

Several general textbooks include sections on electricity which give a usefil introduction to the subject. These include Bracegirdle (1973), Cossons (1987), Smger et al (1958, vol v) and Trinder 1992 (various entries) Industry produced booklets (eg Electricity Council 1966, Bowers undated, Electricity Association publicity material) give easily digestible summaries of how power is generated, how the industry is organised and what its broad history has been

For academic works on the British industry, the main sources are as follows Byatt (1979), gives a comprehensive account of the period 1875-1914. The two books by Hannah (1979, 1982) give a definitive history of the industry in Britain from its inception to 1963 A separate earlier article by Hannah (1977) covers the history of the CEB Bowers (1982) gives a good technological history. The chronology produced by the Electricity Council (1982b) is also a useful reference work Older but still usefil references include Dunsheath (1962), Hennessey (1972), Self and Watson (1952), Ballin (1946) and Carr (1944) Parsons (1939) gives a valuable account of a series of eariy stations and supply systems

Some aspects of the industry neglected in these works are to an extent covered by specialist articles These include a series of important works by the late Gordon Tucker. For example Tucker (1977d) describes the use of refuse destructors for generating electricity, and Tucker (1977c) is an account of several early hydro-electricity stations. Traction is broadly covered in the general texts and in tramway/railway literature (eg Klapper 1961), but has probably received inadequate attention Industrial generation and use of electricity is certainly understudied Jones and Tarkenter (1992) give a (rather poor) summary of electricity in coal mining, Pattenden (1977, 1979) has discussed the use of waste heat and gas in North East England, electricity in the iron and steel industry is briefly covered in various works by Gale (eg 1969); and works on the textile industry give some discussion of the role of electricity (eg Williams and Famie 1992, Giles and Goodall 1992)

A particularly usefil source is the annually produced *Papers presented to the IEE weekend meetings on the history of Electrical Engineering* which, since 1976, has included many usefil and important articles relating both to national and local studies.

7.2 Regional Works

The series of *Bibliographies of Industrial Archaeology and Industrial History* by Greenwood (1985; 1987, 1988; 1990) provide the quickest inroad to what had, by the date of each volume, been published for North England (1985), the Midlands (1987), London (1988), and the South East (1990).

Unfortunately, very few regional studies of physical remains have been published The notable exception is the work by Tucker for the West Midlands (Tucker 1977b), and the South West (Tucker (1972; 1977a). Linsley (1976) has also given a brief overview

for the North East and Brooks (1992) has examined the Manchester area Historical accounts of the regions and specific undertakings have been put together by, amongst others, Hatcher (1985), Hennessey (1976a) and Pattendon (1976, 1979, 1982) for the North East and Yorkshire, Strange (1983) for the East Midlands, Bourne (1989), Boyd and Stamp (1979) and Brooke (1980) for London, Woodward (1991) for Liverpool, and Swale (1963) for Manchester Examination of specific sites is also hmited Examples are Iriam (1989), Strange (1980), Tucker (1977c) and Stratton (forthcoming)

7.3 Contemporary Works

The *Journal of the Institution of Electrical Engineers* contains a considerable amount of valuable historical and technical information for all stages of development of the industry from 1890s on Similarly useful are the *Institution of Civil Engineers Proceedings*, *Institution of Mechanical Engineers Proceedings*, *Electrical and Electronics Trades Directory*, *Electrical Review*, *Electrical Times*, *Electrician*, *Engineer*, and *Garcke's Manual of Electrical Undertakings* These all include contemporary illustrations

Specific valuable articles and publications on power station design and practice are (in chronological order) those by Merz and McLellan (1904), Peach (1904), MacLean (1909), Lamb and Baumann (1938), Pearce (1939), Pask (1951), Say (1968), and the CEGB (1968) There are many other useful articles on other aspects of the industry, for example Wright and Marshall (1929) on the National Grid, Robertson (1909) on refuse destructors, Andrews (1909) on gas engines; and Robertson (1913) on waste heat and gas There are also numerous contemporary accounts of specific sites, for example Anon (1900) on Gloucester, Fawcus and Cowan (1890) on Keswick, and Hopkinson (1894) on Manchester

7.4 Primary Records

The fate of individual company archives and archives of municipal undertakings appears to vary widely around the country and tracking them in detail would be a considerable task In theory many early, small undertakings were taken over by later larger undertakings With nationalisation, these company's archives passed to what became the *CEGB* either through its central or its regional offices and/or to the regional distribution boards Prior to privatisation in 1990, the *CEGB* regional offices were wound down At privatisation, these offices were passed to one or other of the new generating companies At the same time the distributing boards became independent The *CEGB* library, including some archive material is currently held at *National Power's* Swindon headquarters This includes indexed material on the activities of *Electricity Commissioners*, the *CEB*, *BEA*, *CEA* and *CEGB*, files on individual power stations including brochures, press cuttings and photographs, and a large book collection and journal mns

The *Electricity Council* also held an archive, to which was passed at least some of the material previously held by regional distribution boards This archive was passed to the Greater Manchester Museum of Science and Industry in the 1980s This again includes a large number of books and journal runs together with more files on individual stations containing photographs, written material and drawings

The fate of any material held by the *CEGB*'s regional offices is less certain. The South East regional office at Bankside House in London passed to the *National Grid Company* in 1990 but is now closed and *National Grid* have a new headquarters in Coventry. The South West region's Bristol office passed to *Nuclear Electric*. It is also now closed and *Nuclear Electric* have relocated to Gloucester. The Midlands region's Solihull office passed to Power Gen who are currently (April 1994), in the process of

moving The North West region's 'Europa House' office in Stockport passed to *Nuclear Electric*, but had been closed down before privatisation The North East region's Harrogate office passed to *National Power* and is still open and functioning (for data processing and accounting) In no case is it clear if archives survived to privatisation and if so what has happened subsequently District offices have not been checked methodically. However in at least two cases archives appear to have been preserved *Southern Electric* opened and fitted the Southern Electric Museum Through the actions of its curator about five years ago the Museum acquired a large amount of archive material including written accounts, and photographs of individual sites (the material is un-indexed) In the Newcastle area, the *Tyne & Wear Archives Services* appears to hold records for electricity companies from 1888 on This includes the *North East Electricity Board* archives, *NESCo* archives, *Merz and MacLellan* archives and *Joseph Swan* material, although the extent and quality of this material has not been examined Determination of the level of survival of other industry archives should be a priority

The Institution of Electrical Engineers archive department holds archives relating to the IEE but including material relating to the Croydon A, Stepney Battersea and Deptford power stations The library holds a specialist collection of books and journal runs In addition to the Electricity Council archives, the Greater Manchester Museum of Science and Engineering archive department holds runs of journals and a large book collection The *National Buildings Record*, maintained by the *RCHME* holds a variety of collections of photographs These have not been directly consulted but some at least are known to contain early records of power stations (see RCHME 1991; 1993).

In 1993 the *RCAHMS* acquired the South of Scotland Electricity Board archive This contains 201 albums of photographs and a large quantity of documentary material. This highlights the potential of such equivalent archives in England In addition the *RCAHMS* holds the Sir William Arrol Collection (1987/2) which includes a series of photographs of English power stations under construction (Bankside, Barton, Battersea, Belvedere North and South, Bow, Carrington A and B, Castle Donnington, Croydon, Deptford, East and West, Drax, Dungeness, Hartlepool, Heysham, Ince, King's North, Portishead, Ribble, Stuart Street, Willesdon) This again highlights the potential value of electrical engineering company archives (both here and abroad) in relation to the generating industry.

7.5 Museum Collections

The notable collections of material relating to the electricity industry are as follows The *GMMSI* (curator Alan Wilson) has the national electricity gallery with 1920s plant and a wide range of other material The *Science Museum* (Dr Brian Bowers) in London has a large collection of plant of wide variety in type and date Two specialist museums, the Southern Electric Museum and the Milne Museum have notable collections of early generating and transmission equipment The *Newcastle-upon-Tyne Museum of Science and Engineering* (John Clayson) has a large collection including early generating equipment. The *Birmingham Science and Industry Museum* also has a collection of early generating and transmission equipment. In addition the *Royal Institution* has restored *Michael Faraday's Laboratory* and maintains a Museum adjacent to it

7.6 Sources for Step 2 Data and Consultation

A large number of individuals have an interest in the history of the industry. A particular grouping is the *IEE History of Technology Group* who have published papers from their annual weekend meetings since 1973, and may be contacted through Lenore Symons Amongst the members of the group is Dr Patrick Strange, who has a particular knowledge of the East Midlands He also has a special interest in the early

industry and has compiled a comprehensive card index of electricity undertakings and installations that existed up to 1900 In addition Dr Brian Bowers has a comprehensive knowledge of the technical history of the industry The curators of the two specialist electricity industry museums also have considerable knowledge and should be consulted John Norris at the Milne Museum and John Newton at the Southern Electric Museum

The *RCHME* Threatened Buildings Section (Swindon Office) has recently highlighted power generation sites as a priority for recording Work is ongoing and is the responsibility of Mike Williams Survey work in the East Thames corridor is intended to include Electric Power in 1994 Dr Peter Wakelin (Cadw) and Dr Miles Oglethorpe (RCAHMS) should be consulted for comparative information in Wales and Scotland

Records held by the *RCHME* include the *National Record of Industrial Monuments* (now a collection within the *NBR*) which has not been directly consulted but may include relevant site records The *NAR* has been consulted and holds a computer record for 18 generating sites, including 5 listed buildings (although information where checked was out of date) The *RCHME* also holds the only publicly accessible complete set of *Lists of Buildings of Special Architectural or Historic Interest* This is currently being computerised and was not directly consulted for the step 1 report

A questionnaire was circulated to 46 County Sites and Monuments Records and six National Park Officers Of the 39 SMR respondents all were very helpful, but few were able to list more than two or three sites The exceptions were Buckinghamshire, Devon, Gloucestershire, Greater London, Greater Manchester, Lincolnshire, Shropshire and the West Midlands The Peak District and Yorkshire Dales Park Officers also gave useful lists In all cases the lists are far from complete or representative.

The questionnaire was also circulated to 50 AIA affiliated societies Of the 23 respondents, again all were helpful and the majority gave useful information (generally fuller than the equivalent SMR) All expressed willingness to provide further information for the step 2 work

In addition, the following individuals (identified from SMRs, AIA societies and the IEE Group) were identified as having particular knowledge in their field or area Most forwarded lists of sites and should be consulted for step 2 data. David Alderton (East Anglia), Nigel Crowe (British Waterways), Shane Gould (Cranstone Consultancy), Jane Hatcher (Richmondshire), Chris Lester (Lincoln), Stafford Linsley (North East), Robin Minnitt (Wensleydale), Newcommen Society, Michael Stratton (Ironbridge Institute), Peter Stephens (PHEW), Richard Holder (Victorian Society)

8. PRIORITIES AND RECOMMENDATIONS

The history of the electricity industry is a topic of international importance in terms both of scientific and technological development and in economic history The remains of Britain's industry for the period up to World War I have the potential to contribute to our knowledge of these fields and are therefore of international significance From the 1920s, technological development was less significant, however the establishment of the national grid and the focusing on large 'selected' stations to feed it, was of major national importance Subsequent development of the industry is dominated by increases of scale and efficiency and is of less technological significance.

The level of survival of sites is currently unstudied and unquantified However, published works together with responses received to a questionnaire suggest the following. An important factor in the potential survival of generating and transmission sites is their historically short working lifetime, resulting from the pace of technological improvements A further factor is increasing scale of sites. In the period to 1919, the general pattern was for numerous small generating stations with limited distribution areas Some buildings, particularly corn mills, were converted for use as generating stations in this and later periods Undertakings run by municipal authorities often built structures with architectural pretensions and many appear to survive in at least fragmentary form, although usually reused and with no trace of plant Early temporary sites have very little chance of survival By contrast small country estate sites offer the greatest potential for survival of whole systems with *in situ* plant, as they were often simply abandoned when mains electricity became available. Some hospital installations may survive in use Industry installations are less likely to survive Large power stations were being built from the 1890s and became particularly common from the 1920s on To 1948 these stations were generally in urban areas occupying valuable land However, architectural distinction or continued alternative use within the electricity industry seems to have led to the survival of some sites For the period after 1948, some stations remain in use (see Table 9) Their size, rural locations (with potential commercial value of the large areas of land occupied) and safety considerations make them vulnerable to rapid demolition upon closure

Currently there appear to be no Scheduled Monuments representing the electricity industry Sites protected under the lists of historic buildings are not currently indexed and have not been evaluated Broadly, MPP policy should aim at protection of a balanced sample of sites covering the chronological, regional, and typological range of the industry In assessing sites the following themes should be considered

1 For each period, preservation of complete station layouts should have a priority

2 For each period, there should be a representative sample of each power station type, together with the major technological and organisational changes within them.

3 For each period there should be a representative sample of architectural variety, specifically showing the range of constmctional techniques and materials (wood, brick, stone, steel-frame, concrete) and architectural styles employed These should include buildings converted to a generating function.

4 Overall there should be a representative sample of the full range of processes used on generating and transmission sites Published works tend to emphasise prime movers, generators and sub-stations at the neglect of other aspects, for example chimneys, cooling towers, *waste product handling, fuel delivery facilities, auxiliary machinery and ancillary buildings*

5 For the periods to 1831 and 1831-78, representation of the industry is largely through museum collections However any laboratories would be of major significance

6 For the penod prior to c1919 there should be a representative sample of sites reflecting competing technological practices (eg ac versus dc, steam engines versus turbines) and the variations in power station and sub-station design

7. For the penod 1888-1919, (ie prior to establishment of the national grid) and to a lesser extent for the period 1919-48 (ie prior to nationalisation) there should be a representative sample of 'regional' variation in the sense of the following
   - Municipal authorities versus power companies in urban areas
   - Generation for particular functions (lighting, traction, each industry - textiles, mining, iron and steel, engineering etc) Beyond the major industries the practice of achieving this will probably be better done under the MPP examination of each industry
   - Rural and small scale generation Country estate installations are a priority for preserving complete generation and supply systems with *in situ* plant Early mral installations and wartime arrangements seem particularly understudied

8 For the period 1919-48, a period of critical reorganisation of the industry on a national level, a representative sample of 'selected' stations and national grid transmission sites should contrast with the samples of item 7.

9 For the period after 1948, in common with other industries, Britain gradually lost its position of intemational importance in the electricity industry However, electricity generation had become the prime power source upon which virtually all aspects of the nations life depended, power stations were exceptionally prominent landscape features and the industry was organised firmly as a national resource with stations siting related to coalfields and water supply and a broad policy of lessening the dependence on coal The size of the structures involved poses considerable preservation problems, but a selection of sites should be recommended for preservation, reflecting these aspects of the industry

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Sadler, E H	1977		Tower supplies for early searchlights at Tynemouth'	Tyne Ind Archaecl Group Newsl, no 17, 7-9
Say, M	1968		The Electrical Engineer's Reference Book	Feltham Newnes Books
Self, H & Watson, E M	1952		Electricity Supply in Great Britain its development and orgamsation	London Allen & Unwin
Shaw, A H	1989		'Edwardian Elegance and Industry Hydro-electric power in Snowdoma in the early 1900s'	Pares presented to the 17th IEE weekend meeting, 3/1-21
Singer, C et al	1958		A History of Technology	Oxford Clarendon Press
Smart, J H S	1983		'The Edmonton refuse-fired electricity generating plant'	Papers presented to the 11th IEE weekend meeting, 7/1-31
Snell, J F C	1911		Power House Design	
Southampton Corporation, Electricity Dept	1946		Jubilee of the electricity undertaking, 27 April 1946	
Southampton Corporation, Electricity Dept	1948		War History of the undertaking	
Stevens, R A	1977		'Brittama Colliery'	Papers presented to the 5th IEE weekend meeting, 8/1-2.
Storey, J	1895		Historical Sketch of some of the principal works and undertakings of the council of the borough of Leicester	Leicester

Strange, P	1978		'The Earliest Public Electricity Supply The Evidence of Chesterfield and Godalming 1881-84'	Papers presented to the 6th IEE weekend meeting, 145-57
Strange, P	1979		'Early Electricity Supply in Britain Chesterfield and Godalming'	Proc Instn Elect Engrs, cxxvi, 863-68
Strange, P	1980		'Early Electricity Supply The Hydro-electric Scheme at Chatsworth'	Papers presented to the 8th weekend meeting, 86-98
Strange, P	1983		'The Early History of the Derbyshire and Nottinghamshire Electric Power Company'	Papers presented to the 11th IEE weekend meeting, 5/1-11
Stratton, M	forth-coming		Ironbridge and the Electric Revolution. The history of electricity generation at Ironbridge A & B Power Stations	National Power
Swale, W E	1963		Forerunners of the North-Western Electricity Board	Manchester NW Elec Board
Symons, E D & Tucker, D G	1975		'An Interview with Mr A B Cousins of Merthyr Tydfil - Power Station Engineer and Inventor of the Early 1900s'	Papers presented to the 3rd IEE weekend meeting, 3/1-7
Taylor, R	1979		'Swan's Electric Light at Cragside'	Papers presented to the 7th IEE weekend meeting, 12-22
Thompson, W J	1974		Industrial Archaeology in North Staffordshire	Hartington
Trinder, B (ed)	1992		The Blackwell Encyclopedia of Industrial Archaeology	Oxford Blackwell
Tucker, D G	1972		'The Beginnings of Electricity Supply in Bristol, 1889-1902'	Bristol Ind Archaeol Soc Journal, 5, 11-18
Tucker, D G	1974		'Half a century of hydro-electricity at Monmouth'	Presenting Monmouthshire (J Mon Local Hist Council), 37, 27-38
Tucker, D G	1975		'Early Electrical Systems in Collieries The Trafalgar Colbery in the Forest of Dean and the Brain Family'	Papers presented to the 3rd IEE weekend meeting, 12/1-11
Tucker, D G	1977	a	'Electricity from Town Refuse The St Pancras Fiasco, 1893-1900'	Papers presented to the 6th IEE weekend meeting, 94-9
Tucker, D G	1977	b	'Electricity Generating Stations for Public Supply in the West Midlands 188-1977'	West Midlands Studies, 10, 8-28
Tucker, D G	1977	c	'Hydro-electricity for public supply in Britain, 1881-94'	Ind Archaeol Review, 1/2,126-63
Tucker, D G	1977	d	'Refuse Destructors and their use for Generating Electricity. A Century of development'	Ind Archaeol Review, 2/1, 5-27.
Tucker, D G	1978		How Towns got Electric Light and Tramways. A Case study of Gios and neighbouring towns	London Science Museum
Tucker, D G	1979		'Rural electrification and the pioneering scheme of the Hereford Corporation (1918-1928)'	Trans Newcommen Soc, b, 111-28

Tucker, D G	1983	'The Generation of Electricity from Refuse an historical introduction'	Papers presented to the 11th IEE weekend meeting, 6/1-4
Tumbull, J	1979	'The Honorary Sir Charles Parsons and Electricity Supply'	Papers presented to the 7th IEE weekend meeting, 26-41
Tumbull, J C	1976	'Early Applications of Electricity in North Yorkshire and South Durham'	Papers presented at the 4th IEE weekend meeting, 14-18
Tyson, S	1972	'The Limton Lock Hydro-electric Power Station'	Indust Archaeol, 9/1, 48-57
Valenune, A S & Bergstrom, E M	1935	'Hydro-electric development in Great Britam with special reference to the works of the Grampian Electricity Supply Co'	JIEE 76
Wade, J S	1976	Tandon Dene to Carville'	Papers presented at the 4th IEE weekend meeting, 36-43
Warburton, R	1984	'Electricity Generation in Bolton'	Papers presented to the 12th IEE weekend meeting, 10/1-12
Waters, L	1990	Rail centres Reading	Ian Allen Ltd
White, P R	1971	'Some Further Notes on Industrial Archaeology in the Grimsby Area'	Lincs Ind Archaeol, 6/4, 60
Whittick, A	1974	European Architecture in the twenueth century	Aylesbury Leonard Hill Books
Williams, M & Farine, D A	1992	Cotton Mills in Manchester	Preston Carnegie Pubbshing
Wood, J L	1983	'The Transition from Reciprocating Engines to Turbines in Electricity Generation'	Papers presented to the 11th IEE weekend meeting, 12/1-14
Woodward, G	1991	'Electricity in Victorian Liverpool'	Papers presented to the 19th IEE weekend meeting, 2/1-11
Woodward, G	1993	'The Liverpool Overhead Railway A Pioneer in Rapid Transit'	Papers presented to the 21st IEE weekend meeting, 12-21
Wright, J & Marshall, C W	1929	'The Construction of the "Grid" Transmission System in Great Britain'	JIEE 67, 685 on

APPENDIX 1 - TABLES

Table 1 Power station types

Group	Type
Fuel-fired steam generation	coal-fired
	oil-fired
	dual (coal & oil)
	gas-fired
	waste heat & gas
	refuse
	nuclear
Water-powered generation	hydro-electric
	pumped storage
Combustion-powered generation	diesel engine
	gas engine
	gas turbine

Table 2 Growth in number of power stations, 1889-1912

by Jan 1889	26 central stations, 17 being built
by Jan 1890	46 central stations
by Jan 1891	54 central stations
In 1894	c100 stations (1/4 municipal)
end of 1905	384 stations (40 destructor stations)
In 1912	c400 stations (c80 destructor stations)

Table 3 Increase in output of standard generating sets, 1956-70

Date	Size
1956	100 MW
1958	120 MW
1959	200 MW
1962	275 MW
1964	300 MW
1965	350 MW
1966	500 MW
1970	600 MW

Table 4 Selected power installations to 1888

Date from	To	Details	Suppher and type		
1877		Atlas no 3 Mill, Bohon (lighting)	?		industry
14 Oct 1878	event	Sheffield Bramall Lane football match	John Tasker		site (portable)
Nov 1878	few months	London Victona Embankntent, Mansion House, Holbon Viaduct, Billmgsgate Market	Societe Generale d'Electncite	dc	street
1878	onwards	Cragside couotry estate	Williamsoo broc of Keodal for Sir William Armstrong	dc	pn vate (hydro)
1878		Trafalgar oolliery, Glos (surface lighting)	W B Brain	dc	industry
1879		Severn Bndge construction	Pyramid Electnc Light Co (Brain?)		industry (portable)
1879	event	London Alexandra Palace & others	Crompton portable sets hired out		portable
1880		Glasgow GPO & railway stations	British Electnc Co and Crompton		site
Jan 1881		Cragside country estate (Swan filament lamps installed)	Joseph Swan	dc	pn vate (hydro)
Jan 1881	Mar 1883	Norwich supply	Crompton	dc	street
Sept 1881	Apr 1884	Cockermouth supply			street?
Sept 1881	Apr 1884	Codalming supply	Calder & Barrett, later Siemens	ac	public (hydro)
Oct 1881	Mar 1884	Chesterfield supply	Hammond & Co	dc	public
Oct 1881		London Savoy theatre (filament lamps)	Siemens bros		site
1881		London to Bnghton train (filament lamps)			site
1881		London House of Commons (filament lamps)	Crompton		site
Jan 1882	Sept 1886	London Holborn Viaduct	Edison	dc	public
Feb 1882	onwards	Bnghton supply	Hammond & Co	dc	public
Mar 1882		Hastings supply	Hammond & Co	dc	public
Sept 1882		Eastbourne supply	Hammond & Co	dc	public
Dec 1882		Trafalgar oolliery, Glos (pumping/wmding)	W B Bram		industry
1882		London Law Courts, Strand	Crompton		site
1882		London King's Cross station	Crompton		site
1882		Berechurch hall, near Colchester	Crompton		pn vate
1882		Nottmgham lighting destructor			site (destructor)
1883		London Crovesnor Gallery	Sir Coutts Lindsay	ac	site
Nov 1883	1884	London Metropolitan Railway Company, Circle Line	Caulard and Gibbs	ac	rail
1883		Volk's electnc railway, Bnghton	Magnus Volk	dc	rail
1883		Gtants Causeway Portwich and Bnish Valley Railway	Siemens	dc	rall (hydro)
1884	1886	Colchester supply	South Eastern Brush Electnc Light Co Ltd	dc	public
1884		Cardiff supply			public
1885		Glasgow supply			public
1885		Blackpool electnc tramway			rall
Jan 1887		Kensington Court power station	Crompton	dc	public
July 1888	1893	Chelsea, Kensington, Brompton, Knightsbndge	Cadogan Electnc Lighting Company	dc	pubbc

Table 5 Selected power stations, 1889-1914

Date from	Details	Supply Company	Supply		
1889	Chelsea supply	Chelsea Electricity Supply Co	dc		public
1889	Pandon Dene power station	NESCo	dc		public
Sept 1889	Bradford supply - first municipal power station in England	Corporation of Bradford (Siemens plant)	dc		public
1889	Deptford power station -	London Electric Supply Corporation Ltd (Ferranti)	ac		public
1890	Stockwell power station - supplied City & S London Railway, first electrically powered underground railway in world	City & S London Railway	dc		rail
1890	Forth Banks power station - first use of steam turbines	Newcastle & District Electric Lighting Co (DisCo)	ac	1S0kW	public
1891	First condensing turbine set (supplied by Parson)	Cambridge electric Lighting Company			
June 1892	Oxford supply	Oxford Electric Company	dc		public
1892	Morecambe power station - first public station with gas engines	Morecambe Electric Light & Power Co	dc		public
1894	Powick power station - generators driven either by water or by steam	Worcester Corporation		400kW	public (hydro)
1897	Shoreditch refuse destructor - first successful combined destructor/generator station				public
1900	Acton Hall Colliery, Featherstone - first 3-phase turbo-alternator (supplied by Parsons) Powered coal cutting.		ac		industry
1900	Neptune Bank power station - first 3-phase public supply	Walker & Wallsend Union Gas Co (Merz)	ac	2 4 MW	public
1903	Willesden power station - experiments with pulverised fuel	Metropolitan Electric Supply Co			
1904	Falcon Mill, Bolton (motors)	?			industry
1904	Carville 'A' power station - first large power station of modern type, with central control room	NESCo	ac	10MW	public
1906	Greenwich power station - to power London trams Last use of Willans engines	London County Council		3 5MW	rail
1914	Carville 'B' power station - technically advanced station	NESCo	ac	55MW	public

Table 6 Early use of refuse destructors for electricity generation

Date	Town	Details
1882	Nottingham	First production of electricity by steam from destructor
c1890	Southampton	Destructor plant used to generate steam. Mainly for compressed air, but some electricity production. Lit several streets nearby; quickly withdrawn to allow private generating company to light them.
late 1893	Halifax	First public demonstration of electric lighting derived from burning of town refuse, at Halifax. Used destructor, 'elephant'-type boiler, Parsons turbogenerator Powered a searchlight and several lamps
Oct 1894	Ealing	First public electricity supply generated from refuse Electricity works added to existing destructor 250 kW capacity (35kW from refuse) Soon abandoned.
May 1895	Cheltenham	Public electricity supply generated from refuse Electricity works added to existing destructor 176 kW capacity (50kW from destructor) Scheme a success
Aug 1895	St Pancras, London	First combine destructor/generator station into use A technical and economic failure Never successfully supplied steam for the generating plant
1896	Oldham	Public electricity supply generated from refuse in. An electricity works was added on to an existing destructor
June 1897	Shoreditch, London	First successful combined destructor/generator station. 1940, ceased regular operation. 1948, generator dismantled. Destructor operated to 1960s

Table 7 Selected power stations, 1918-47

Date	Power Station	Details
1918	North Tees, Middlesborough	Opened by NESCo at Middlesborough. CEB commissioned the station in 1921 30MW machines, used 1kg coal per kWbour generated, steam temperature of 370C First station to use really high steam pressure (450 lb/sq in) and reheat cycle
1922	Barking 'A', London	First section completed for County of London Electricity Supply Co, with Parsons machines Further machines installed in 1926 Commissioned by CEB in 1925 4x30MW & 4x40 MW seu
1928	Brunsdown 'B'	Had first turboalternator lo generate direct at 33 kV (North Metropolitan Power Co) Parsons 25 MW set
1929	Hams Hall 'A', Burningham	Built by Burningham Corporation, and commissioned by CEB 249MW capacity (with 30MW and 50MW sets) Steam conditions, 350lbs/sq in, 700F
1929	Deptford West, London	In commission. First major construction by London Power Company 35MW and 50MW sets (350 lbs/sq in, 780F)
1930	Dunston 'B'	Built and opened by NESCo in 1930-1 Commissioned by CEB in 1933 6x50MW sets largest and most efficient in Britain, used reheat principle Ocoerated directly at 33kV, avoiding need for transfonner with each generator Used 0 6kg coal per kWHour generated. Steam conditions 600 lbs/sq in, S00F Last turbines designed by Parsons installed here
1933	Barking 'B'	Commissioned by CEB Completed 1940 4x75 MW sets Total capacity on site at 540 MW, largest in Europe
1933	Battersea, London	Commissioned by CEB, of London Power Company Planned as A and B Designed by Sir Leonard Pearce Architectural features by Sir Giles Scott. 3x60MW and 105 MW (largest in Europe) sets (600 lbs/sq in, 830F)
1936	Fulham	Commissioned by CEB 6x60MW sets (600 lbs/sq in, S00F) High thermal efficiency (highest in country in 1948)
Dec 1938	Brunsdown 'A', London	CEB commissioned pioneer high pressure plant (North Metropohtan Power Co) Steam conditions 1900 lbs/sq in, 930F, reheat cycle Two Loeffler forced-circulation boilers
1942	Hams Hall 'B', Birmingham	Commissioned by CEB of Birmingbam Corporation. 330MW capacity 50MW sets (650lbs/sq in, 825F). Highest thermal efficiency in country in 1947 A and B together were largest concentration of generating plant in Europe at time
Dec 1942	Castle Meads, Gloucester	Commissioned by CEB as one of two war emergency power stations Owned by Gloucester Corporation. Utilitarian wartime architecture 2x20MW sets
Dec 1942	Earley, near Reading	Commissioned as one of two war emergency power stations Only station owned by CEB Operated by Edmundson's Electricity Corporation. 2x40MW sets (originally ordered for South Africa)
1944	Battersea 'B', London	First section commissioned 100MW set (1,350lbs/sq in) Second (1951, 60MW set) and third (1955, 100MW set) secuons followed
1947	Meaford 'A', Stone	Fust station to come uito operation after war (North West Midlands JEA) 4x30MW stes

Table 8 Selected power stations, 1948-67

Date	Power Station	Details
Oct 1948	Kingston 'B'	Commissioned by BEA. First of 'nationalised' stations 4x30MW sets
1949	Dunston 'B'	First large-scale application in UK of unit boiler arrangement with reheat steam cycle 50MW set (600lb/sinn, 849/849F)
Aug 1949	Limlebrook 'B'	Commissioning of first hydrogen-cooled alternator in UK, 60MW set at Littlebrook 'B' power station
1950	Staythorpe	Commissioning of first standard 60MW unit with standard steam conditions First of new Trent valley stations, using E Midlands coal
1950	Stourport 'B'	First slag-tap furnace in Britain. 60MW set.
Apr 1952	Keadby	First of 6x60MW sets commissioned. First installation of standard 60MW set with unit boiler arrangement. First BEA engineered new station to commission. 550k lb/h boilers largest to enter service in UK.
Aug 1952	Trafford, Manchester	15MW gas-turbine set put on load. Entered commercial operation in 1957
1952	Bankside 'B'	First 60MW set at commission. First large public supply station specifically designed for oil-firing. Station building by Sir G G Scott. Bankside and Battersea only stations in Britain to have full-scale gas washing plant.
1953	Bold 'A', St Helens	Pithead power station, 4x30MW sets started up Belt conveyor link with colliery
1954	Ashford 'B'	Start up of diesel plant. 5x2MW sets (largest diesel station operated at time)
1954	Stourport 'B'	In commission. 60MW unit, 1500 lb/sq in, 1050F (most advanced steam conditions on public supply system at time
1954	Inoe 'A'	First British station with semi-outdoor design of boiler plant.
1956	Castle Donington, Derby	First 100MW unit. First station to break away from standard 30MW/60MW sets 6x100MW sets, 1500 lbs/sq in, 1050F
1956	Calder Hall 'A' (nuclear)	UKAEA nuclear power station connected to grid. World's first large-scale nuclear power station. 4x23MW sets
1957	Barking 'C'	First cyclone-fired boiler on public supply system
1957	South Denes, Gt Yarmouth	Station had automatic control
1958	Hams Hall 'C', Burmingham	Commissioned by CEGB 390MW capacity
1958	Grimethorpe	Pithead power station of NCB opened. 3x20MW sets, use high-ash coal
Dec 1958	Blyth 'A', Northumberland	First of new standard 120MW sets installed.
1959	Spondon 'H', Derby	Unique in CEGB in supplying nearby British Celanese plant. 3x10MW sets
1959	High Marnham, Retford	Europe's first 200MW set. 2350 lbs/sq in, 1050F (reheat to 1,000F) 5x200MW sets - Europe's first 1,000MW coal-fired station.
1962	Blyth 'B', Northumberland	First 275MW sets installed
1967	Hams Hall 'C', Birmingham	65MW unit converted to dual coal/natural gas firing as experiment. Full conversion of 6 units in 1971

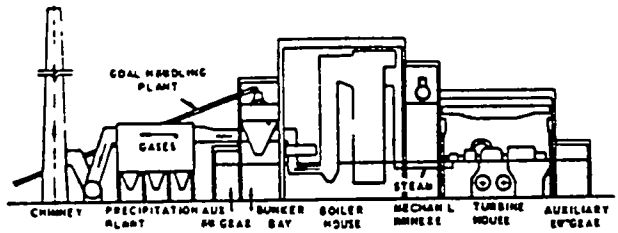
Table 9 Power stations in use in 1993*

	Main companies (Engl & Wales)**					Independents (UK)				
	hydro	coal	oil/gas	nuclr	other	hydro	coal	oil/gas	nuclr	other
1900-09										
1910-19	1									
1920-29	2									
1930-39	1									
1940-49										
1950-59		4					1	1		
1960-69	2	14	4	5				1	2	
1970-79		6	7	2						
1980-89	2		3	4				1		1
1990-					3			1		34
TOTALS	8	24	14	11	3	0	1	4	2	35
Capacity	60 stations 51,360MW					42 stations 6,196MW				

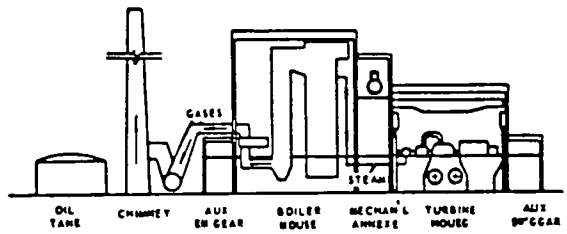
(*Data based on Electricity Association 1993, 49-51)
(** National Grid Company, National Power, Nuclear Electric, Power Gen)

APPENDIX 2 - ILLUSTRATIONS

(a) COAL-FIRED



(b) OIL-FIRED



(c) DUAL FIRED

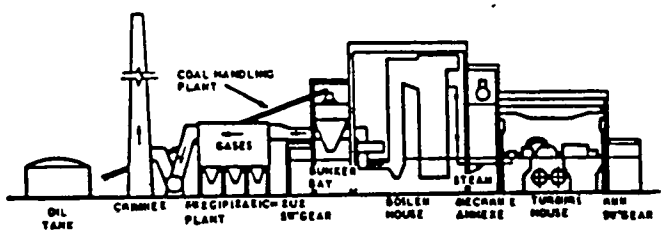
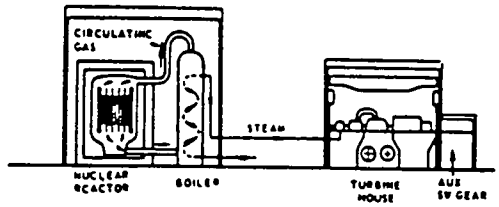
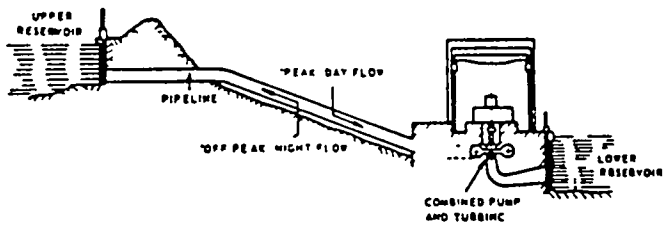


Figure 1. Typical cross-sections of *coal-*, *oil-* and *dual-fired power stations* (CEGB 1971, 33)

(d) NUCLEAR



(e) PUMPED STORAGE



(f) GAS TURBINE

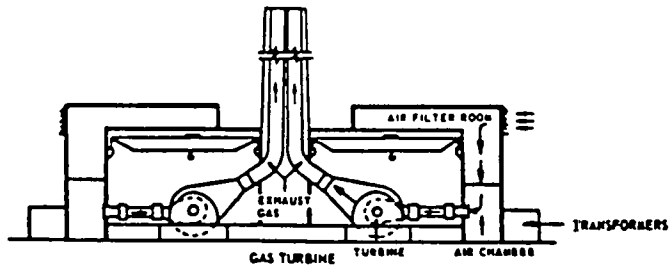


Figure 2 Typical cross-sections of *nuclear, pumped storage* and *gas turbine fired power stations* (CEGB 1971, 34)

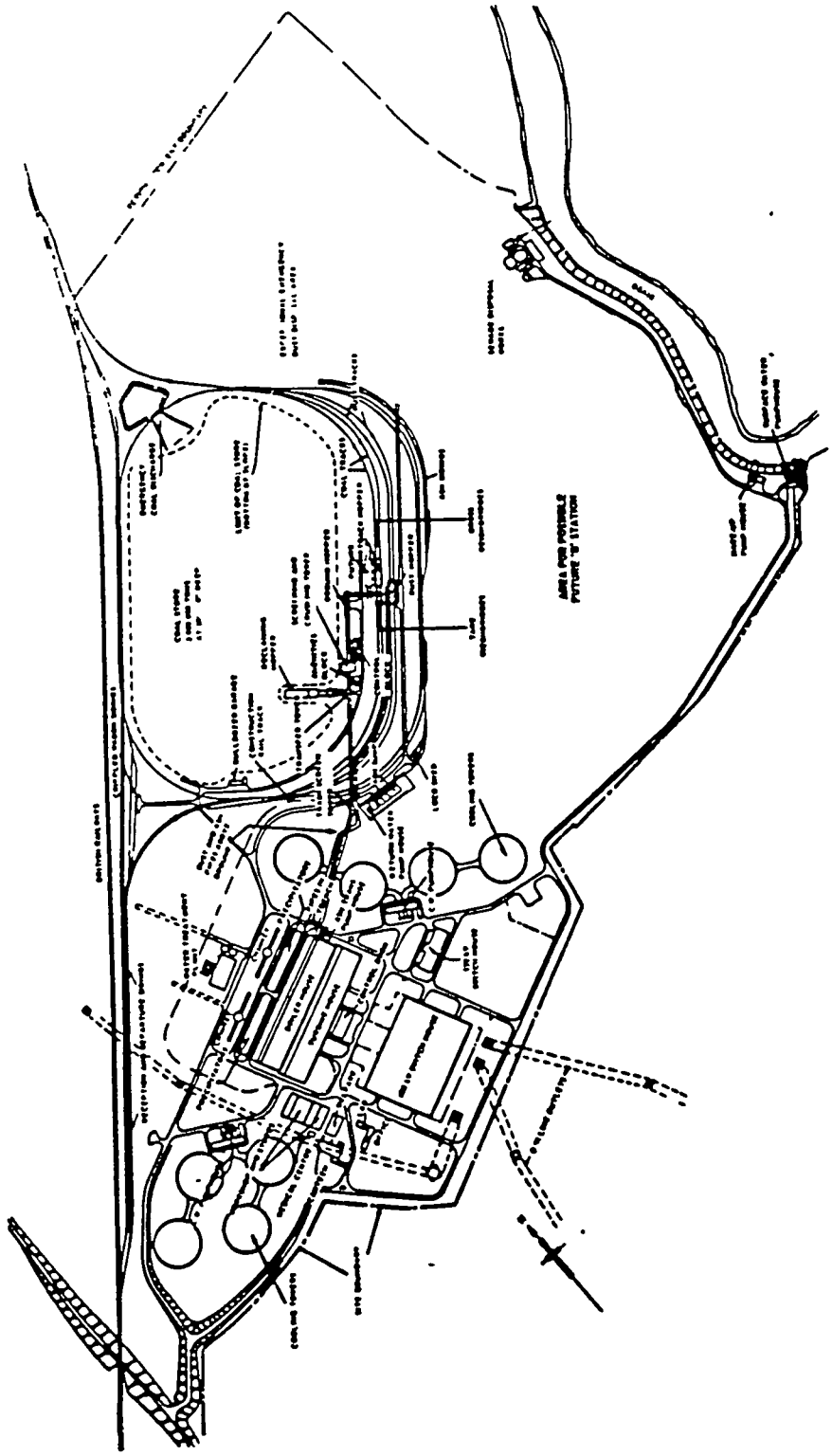
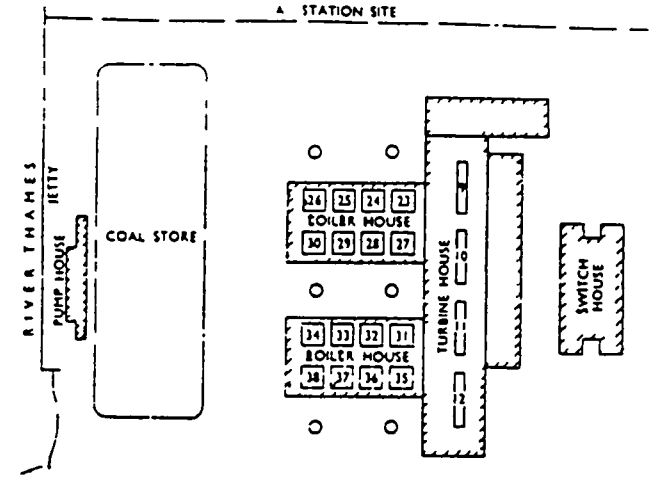


Figure 3 Typical site layout for a 2000MW *coal-fired station* (CEGB 1971, 62)



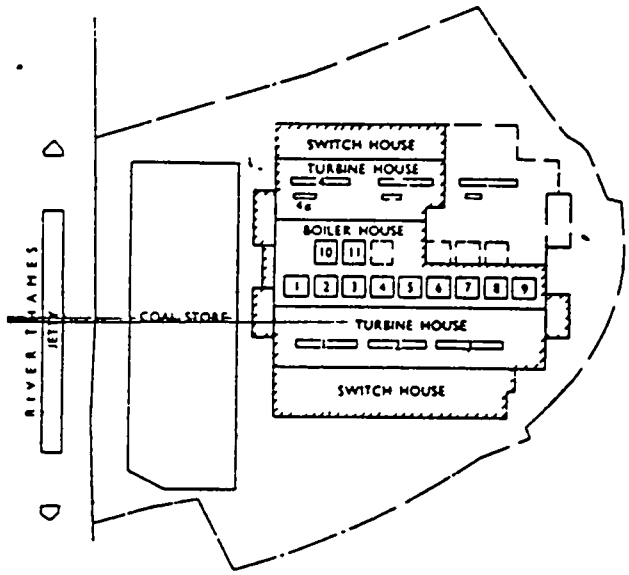
Barking "B" Station:—

Steam condidoiu (turbine stop valve) · 600 lb. per sq. in , 800 deg. F.

Turbines: Not. 9–12, 75,000 kW. B.T.H., 1,500 r.p.m.

Bodem: Nos. 23–38, 205,000–256,000 lb. per hr. Babcock and Wilcox (chain-grate stoker).

Total installed plant capacity, 300,000 kW.



Battertm Station:—

Steam conditions (turbine stop valve): extra high-pressure, 1,350 lb. per sq. in., 950 deg. F.; high-pressure, 600 lb per sq. in., 850 deg. F.

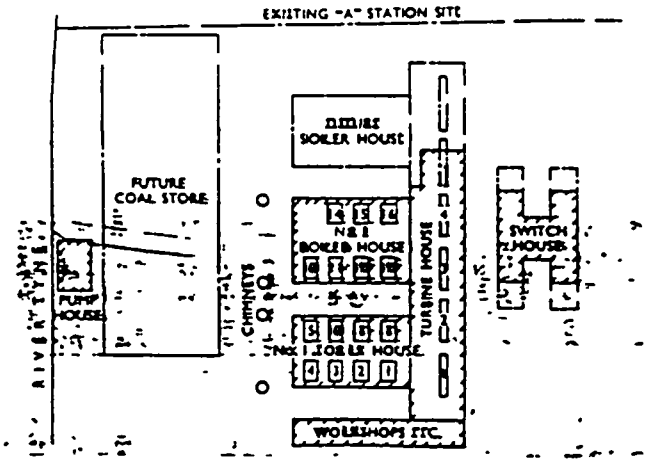
High-pressure turbines: No. 1, 69,000 kW. B.T.H., 1,500 r.p.m.
No. 2, 69,000 kW. Metropolitan-Vickers, 1,500 r.p.m.
No. 3, 105,000 kW. Metropolitan-Vickers, 1,500 r.p.m.

Extra high-pressure turbines: No. 4, 84,000 kW. Metropolitan - Vickers, 1,500 r.p.m. (low-pressure).
No. 4*a*, 16,000 kW. Metropolitan - Vickers, 3,000 r.p.m.

High-pressure boilers: Nos. 1–6, 250,000–312,000 lb. per hr. Babcock and Wilcox (retort stoker).
Nos. 7–9, 300,000-375,000 lb. per hr. Babcock and Wilcox (retort stoker).

Extra high-pressure boilers: Nos. 10 and 11, 440,000–550,000 lb. per hr. Babcock and Wilcox (retort stoker).

Total installed plant capacity, 343,000 kW.



Dunston "B" Station:—

Steam conditions (turbine stop valve): 600 lb. per sq. in., 800 deg. F.; reheat, 150 lb. per sq. in. to 825 deg. F.

Turbines: Nos. 1–4, 50,000 kW. Parsons, 1,500 r.p.m.

Non-tebeat boilers: Nos. 3–6, 150,000 lb. per hr. Clarke, Chapman (chain-grate stoker).
Nos. 11, 12, and 14, 150,000 lb. per hr. Clarke, Chapman (pulverised fuel).

Rebett boilers: Nos. 1, 2, 7, and 8, 125,000 lbs per hr. Babcock and Wilcox (chain-grate stoker).
Nos. 9 and 10, 125,000 lb. pec hr. Babcock and Wilcox (polveriied fuel).
Nos. 15 and 16, 125,000 lb. per hr. Clarke, Chapman (puhverised fuel).

Total installed plant capacity, 200,000 kW.

Figure 4 Power station layouts of Barking 'B', Battersea and Dunston 'B' (Pearce 1939, 325)

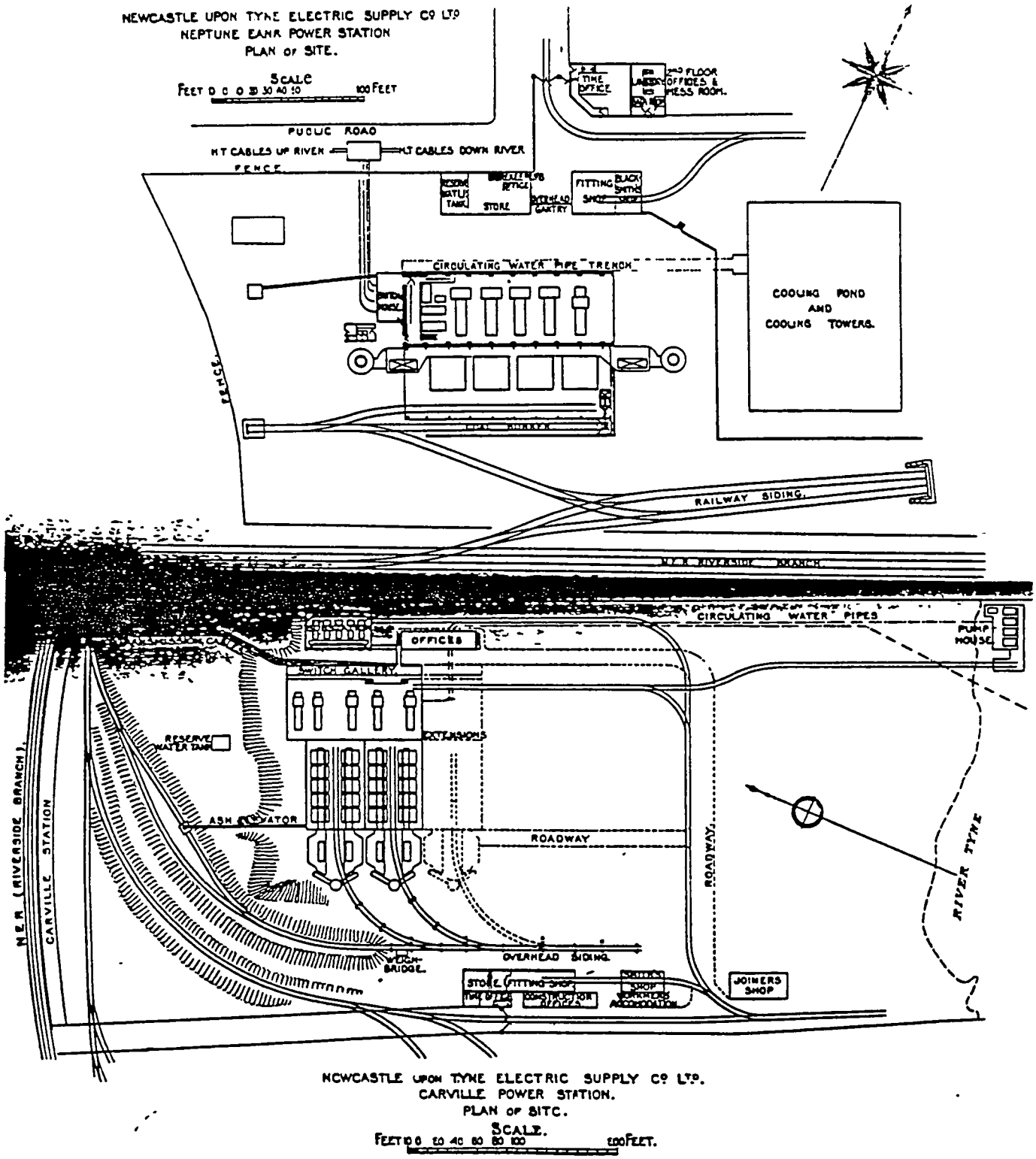


Figure 5 Power station layout of Neptune Bank and Carville
(Merz and McLellan 1904, 710-11)

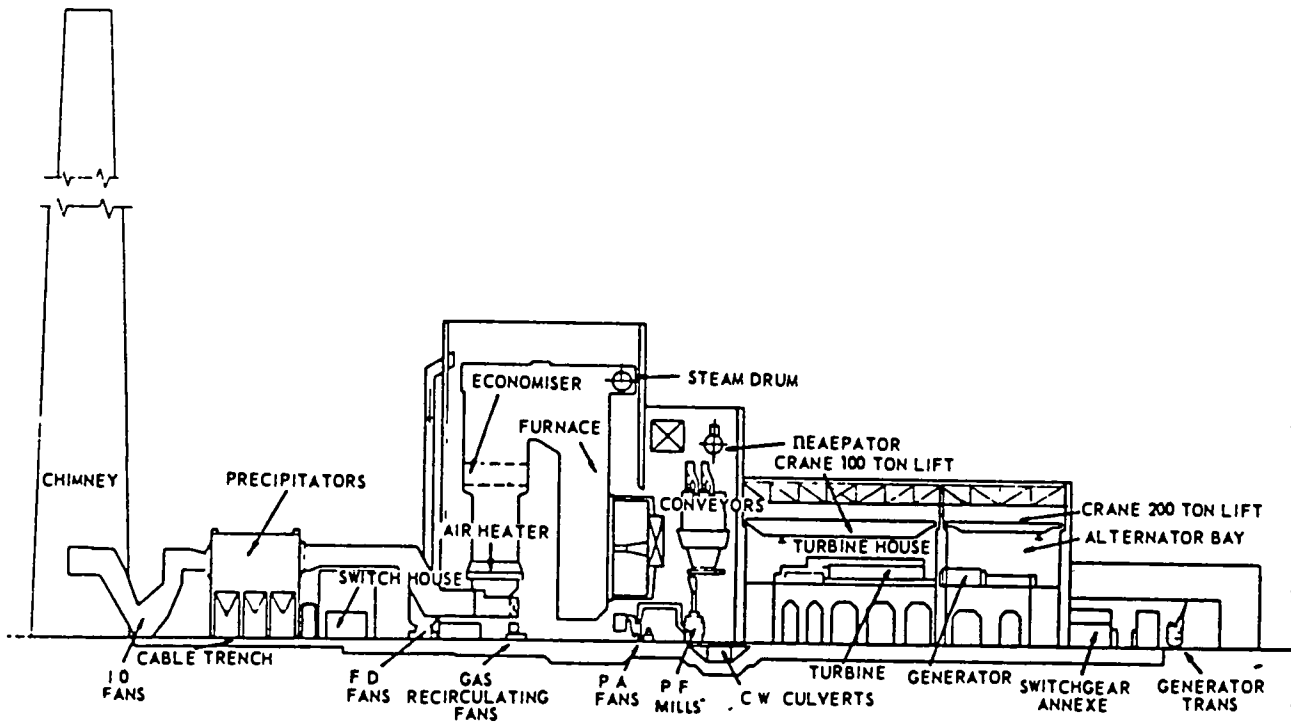


Figure 6 Typical cross section of power station with 500MW units (CEGB 1971, 68)

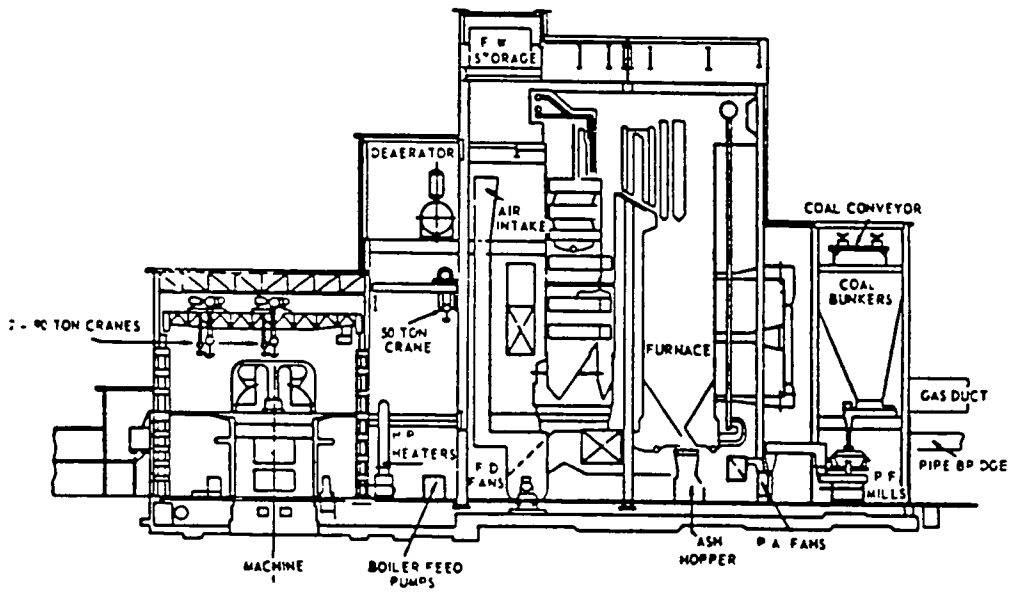


Figure 7. Typical cross section of power hall and boiler house (CEGB 1971, 68)

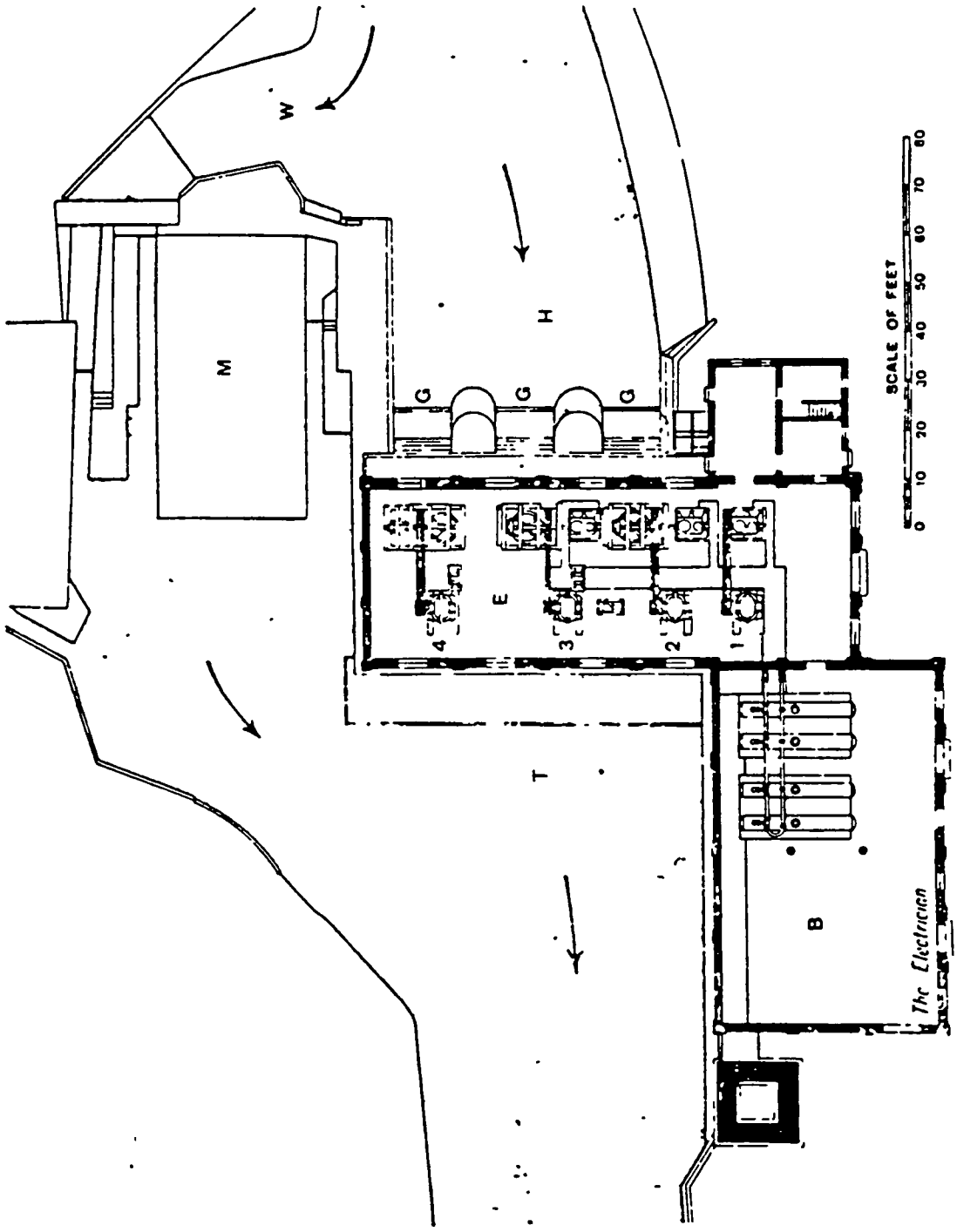
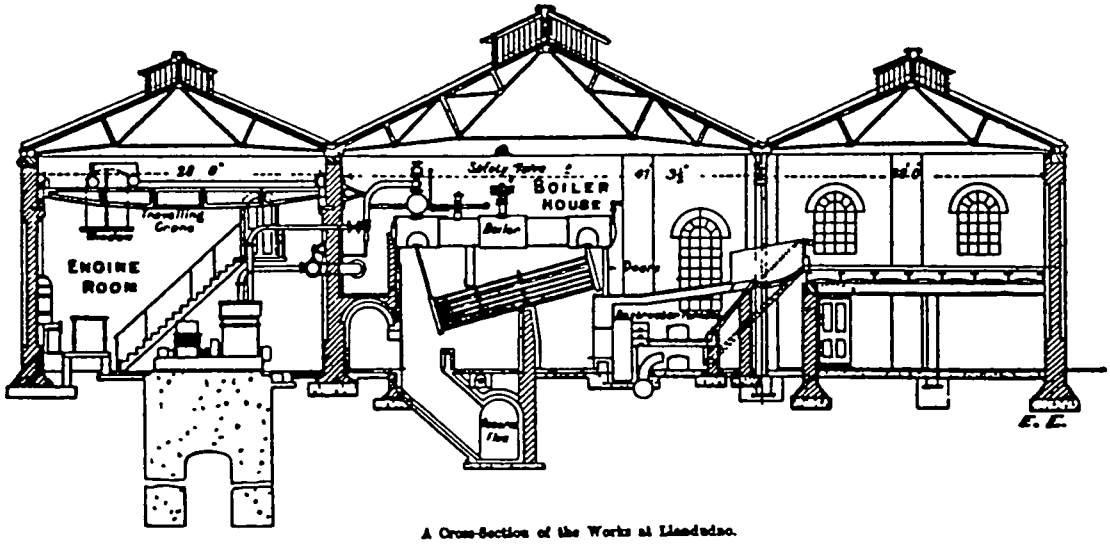


Figure 8 Plan of Powick (1894) *hydro-electric station* (*Electrician*, 33, 5 Oct 1894)



A Cross-Section of the Works at Llandudno.

Figure 9. Cross section of Llanndudno refuse destructor and generating station (*Electrical Engineer*, 22, 1898, 647)

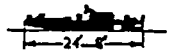
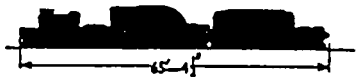
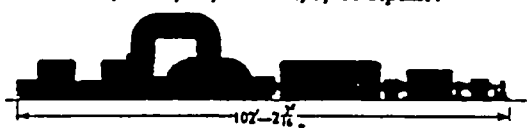
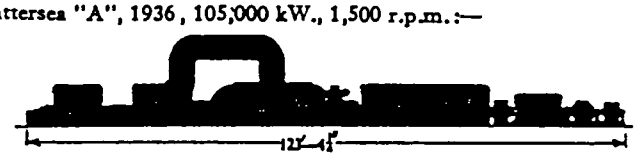
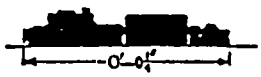
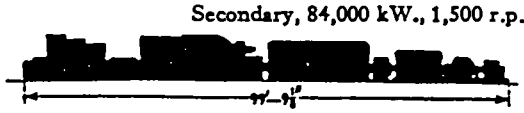
	Steam conditions		No of stages	Ratios	
	Pressure, lb per sq in gauge	Temperature, deg. F.		kW. per sq. ft. floor area	Lb. weight per kW
Manchester Sq., 1895, 350 kW, 3,000 r.p.m.:— 	150	366 (dry sat.)	77	3·55	128
Stuart Street, Manchester, 1907; 5,000 kW., 1,000 r.p.m.:— 	190	500	50	10 1	71·0
Stuart Street, Manchester, 1914; 15,000 kW., 1,000 r.p.m.:— 	190	530	14	25·1	42·0
Stuart Street, Manchester, 1919; 20,000 kW., 1,500 r.p.m.— 	200	600	23	30 8	28·6
Deptford West, 1929; 35,000 kW., 1,500 r.p.m.:— 	350	750	39	30-4	22 1
Barton, 1926; 41,000 kW., 1,500 r.p.m.:— 	350	700	41	24 8	24 1
Deptford West, 1937; 50,000 kW., 1,500 r.p.m.:— 	350	750	41	35·4	22·4
Battersea "A", 1933; 69,000 kW., 1,500 r.p.m.:— 	570	800	47	37·0	19 5
Battersea "A", 1936, 105,000 kW., 1,500 r.p.m.:— 	600	850	44	51·6	16·0
Battersea "B", 1940: Primary, 16,000 kW., 3,000 r.p.m.:— 	1,350	950	12	41·4	14 5
Secondary, 84,000 kW., 1,500 r.p.m.:— 	600	750–850	43		

Figure 10 :Comparative sizes of turbo-alternators, 1895-1940 (Pearce 1939, 328)

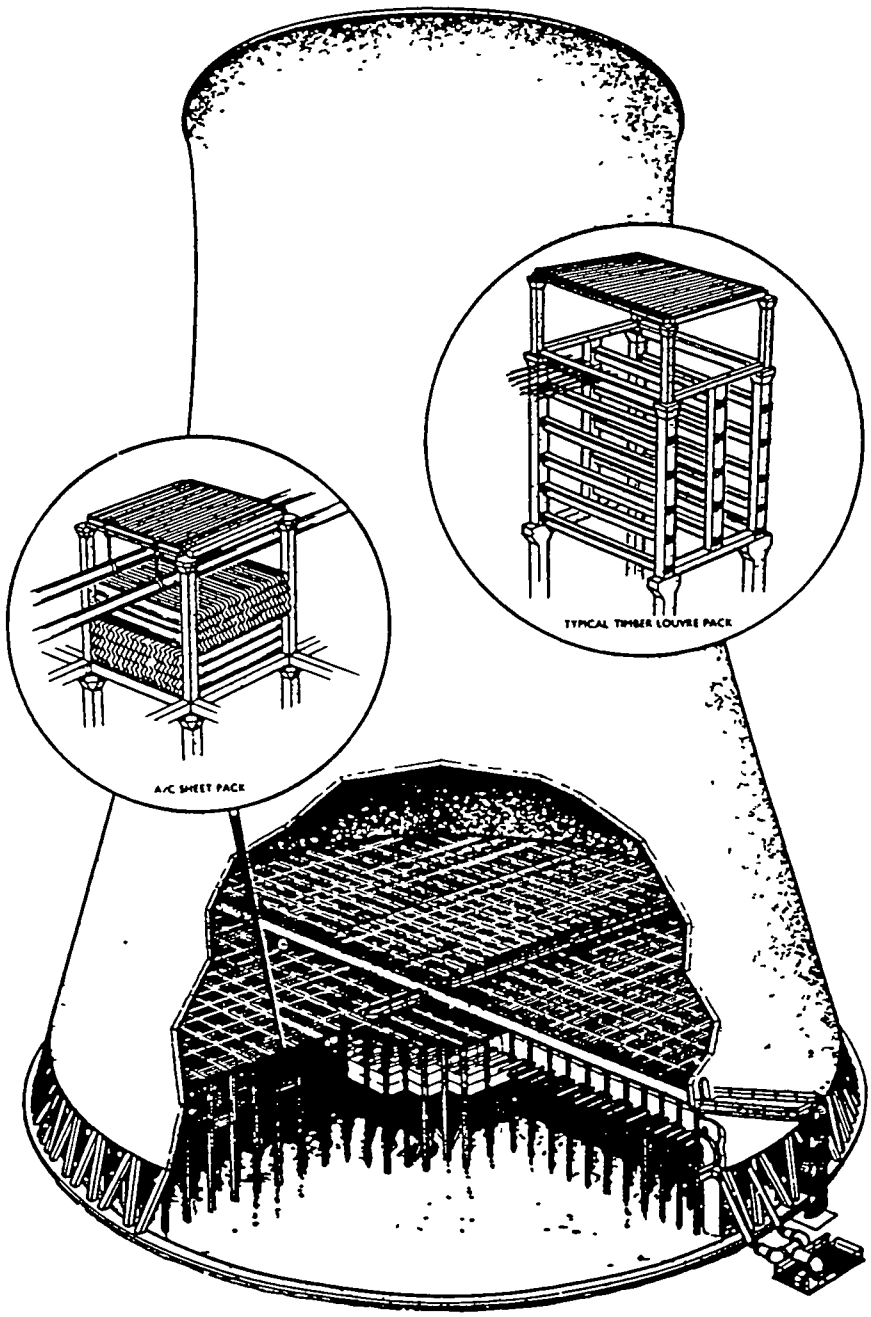


Figure 11: Ferro-concrete cooling tower (CEGB 1971, 247)

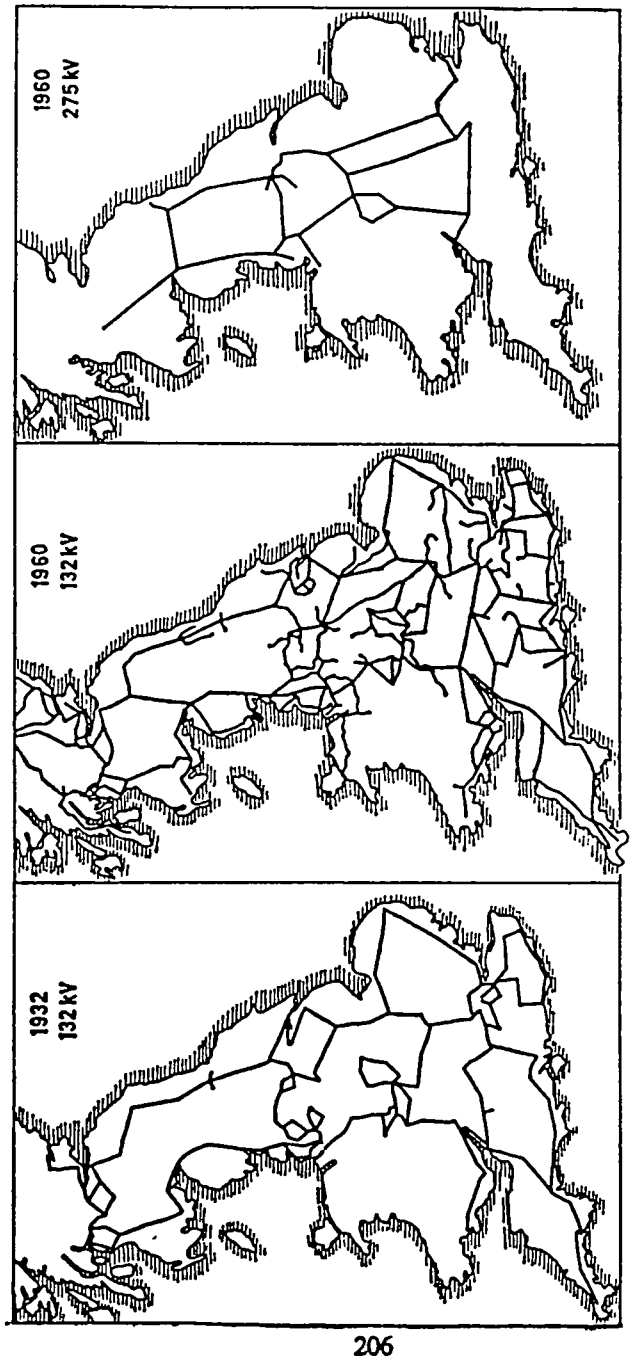


Figure 12. Maps showing extent of *National Grid* in 1932 and 1960 (Dunsheath 1962, 206)

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